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(71) Applicant (for all designated States except US): KT-  
FRETEL CO. LTD. [KR/KR]; 890-20, Daechi-dong,  
Gangnam-gu, Seoul 135-280 (KR).

(72) Inventors; and

(75) Inventors/Applicants (for US only): OH, Young-Min  
[KR/KR]; 127-103 Sibeomhanshin apt., 87 Seo-  
hyeon-dong, Bundang-gu, Seongnam-city, Gyeonggi-do  
463-050 (KR). JANG, Ki-Taeg [KR/KR]; 309-1101

GgummaeulDonga apt., Pyeongchon-dong, Don-  
gan-gu, Anyang-city, Gyeonggi-do 431-070 (KR).  
CHO, Hyung-Sik [KR/KR]; 801-1301 Jinheung apt.,  
Imac-dong, Bundang-gu, Seongnam-city, Gyeonggi-do  
463-904 (KR). SHIN, Hyung-Sup [KR/KR]; 518-105  
Jaegabalbyeoksan apt., 266-3 Siheung-dong, Geum-  
cheon-gu, Seoul 153-031 (KR).

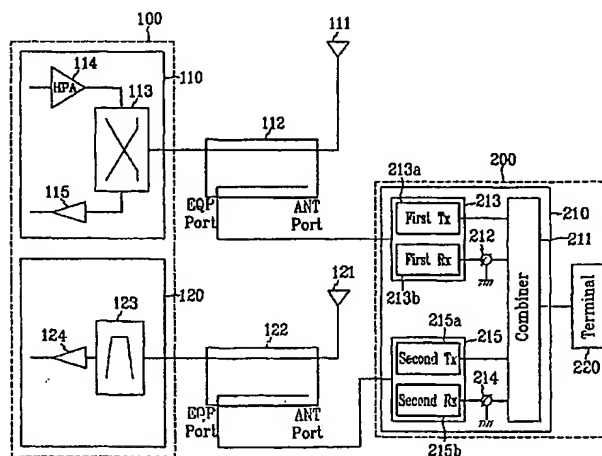
(74) Agent: YOU ME PATENT & LAW FIRM; 825-33  
Tehran Bldg., Yoksam-dong, Kangnam-ku, Seoul  
135-080 (KR).

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(54) Title: DEVICE AND METHOD FOR MEASURING RECEIVE SENSITIVITY OF COMMUNICATION SYSTEM  
INCLUDING RECEIVE-ONLY PATH



(57) Abstract: Disclosed is a device (200) and a method for measuring a receive sensitivity of a communication system having a transmit and receive path and a receive-only path, like a base station (100) employing space diversity by means of one transmit and receive antenna (111) and an additional receive antenna (121). A terminal (220) is connected to the transmit and receive path and to the receive-only path by means of a first (112) and a second coupler (122) and a first (213a) and a second transmitter (215a) whereby the input signals are combined by a combiner (211) to a single signal fed to the terminal (220). Furthermore, the terminal (220) selectively transmits a test signal at selected frequencies to a receive sensitivity measuring path by means of a first (212) and a second (214) switch and a first (213b) and a second (215b) receiver in order to measure the receive sensitivities of the transmit and receive path and the receive-only path of the communication system and to measure the performance of the corresponding communication system.



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## Description

### Device and Method for Measuring Receive Sensitivity of Communication System including Receive-only Path

#### Technical Field

- [1] The present invention relates to a device and method for measuring a receive sensitivity of a communication system including a receive-only path. More specifically, the present invention relates to a device and method for measuring a receive sensitivity of a communication system including a receive-only path for conveniently measuring a receive sensitivity of a receive-only path of a communication system including a transmit and receive path and a receive-only path.

#### Background Art

- [2] In a communication system including a transmit and receive path and a receive-only path, methods for measuring receive sensitivities of the respective paths have been developed in order to measure performance of the paths.
- [3] It is relatively easy to measure the receive sensitivity of the transmit and receive path while the communication system provides services, since the transmit and receive path can communicate with a device for measuring the receive sensitivities.
- [4] However, since the receive-only path has no transmission function, it is not easy to measure the receive sensitivity of the receive-only path while the communication system provides services, and it is not easy to measure the receive sensitivity thereof when the communication system provides no services.
- [5] An exemplified communication system having a general transmit and receive path and a receive-only path is a mobile communication base station which manages three or less FAs (Frequency Assignments).
- [6] The mobile communication base station has two paths A and B as a default, and the path A services 3FA, 5FA, and 7FA, and the path B services 1FA, 2FA, 4FA, and 6FA in the general manner. Therefore, the paths A and B have the transmission and receiving functions when they service three or more FAs. However, in the case of servicing three or less FAs, the path A manages transmission and receiving of three FAs, and the path B includes a receive-only path for diversity of the path A.
- [7] FIG. 1 shows a block diagram for measuring the receive sensitivity of the transmit and receive path.
- [8] Referring to FIG. 1, the base station 100 comprises a transmit and receive antenna 111 for transmitting and receiving 1FA, 2FA, and 3FA at the path A 110, a duplexer

113, an HPA (High Power Amplifier) 114, and a first LNA (Low Noise Amplifier) 115. In addition, a first coupler 112 for measuring the sensitivity is coupled to the transmit and receive antenna 111.

- [9] The path B 120 for a diversity path comprises a receive antenna 121, a second coupler 122, a filter 123, and a second LNA 124.
- [10] The transmit and receive antenna 111 of the path A 110 transmits and receives data through three frequencies of 1FA, 2FA, and 3FA to thus form a transmit and receive path. In this instance, the duplexer 113 couples the HPA 114 to the transmit and receive antenna 111 at the time of transmission, and couples the transmit and receive antenna 111 to the first LNA 115, thereby modifying the data path according to transmission and reception.
- [11] The first coupler 112 is previously combined with the transmit and receive antenna 111 so as to test the performance of the transmit and receive path, and extracts signals transmitted to and received from the path A 110 of the base station 100 according to the coupling effect so as to calculate the measured receive sensitivity.
- [12] The path B 120 is a receive-only path for the diversity path of the transmit and receive antenna 111 of the path A 110, and it transmits the data received at the receive-only antenna 121 to the second LNA 124 through the filter 123, and the receive-only antenna 121 includes a second coupler 122.
- [13] In order to measure the receive sensitivity of the path A 110 which is a transmit and receive path and the path B 120 which is a transmit-only path, a receive sensitivity jg 130 coupled to EQP (Equivalence Point Titration) ports of the first and second couplers 112 and 122 is provided.
- [14] In order to process the receive sensitivity of the path A 110 of the base station 100 in the above configuration, the receive sensitivity jg 130 coupled to the EQP port of the first coupler 112 establishes a lowest signal level which can be received when the base station 100 is normally operated through data transmission and reception with the path A, and transmits the established lowest level signal to the base station 100.
- [15] When normally receiving the lowest level signal transmitted by the receive sensitivity jg 130, the path A 110 of the base station 100 can measure errors of the path of from the receive sensitivity jg 130 to the initial receive terminal of the path A, and the receive sensitivity using the lowest level signal transmitted by the receive sensitivity jg 130.
- [16] However, since the path B 120 is a receive-only path as described above, communication with the receive sensitivity jg 130 is impossible, and it is also impossible

to establish the lowest level signal. Accordingly, it is difficult to measure the receive sensitivity of the path B 120, and the service may be interrupted during a measuring process.

## **Disclosure of Invention**

### **Technical Problem**

- [17] It is an advantage of the present invention to provide a receive sensitivity measuring device and method of a communication system including a receive-only path for easily measuring the receive sensitivity of a receive-only path when a general service is provided, in order to measure performance of a communication system including a receive-only path.

### **Technical Solution**

- [18] In one aspect of the present invention, in a receive sensitivity measuring device including a terminal for transmitting a test signal through communication with a receive sensitivity measuring path so as to measure the receive sensitivity of a communication system including a transmit and receive path and a receive-only path, a receive sensitivity measuring device including a receive-only path comprises:
- [19] a first transmitter for receiving a signal from the transmit and receive path, and transmitting the signal to the terminal;
- [20] a second transmitter for receiving a signal from the receive-only path, and transmitting the signal to the terminal;
- [21] a first receiver for receiving a test signal from the terminal, and transmitting the test signal to the transmit and receive path;
- [22] a second receiver for receiving a test signal from the terminal, and transmitting the test signal to the receive-only path;
- [23] a signal selector, for selecting one of the first and second receivers connected to the signal selector and a receive sensitivity measuring path so that one of the first and second receivers may be selectively connected to the terminal; and
- [24] a combiner, connected to the first and second transmitters and the first and second receivers, for combining a plurality of input signals into a single signal, and transmitting the single signal to the terminal, wherein
- [25] the terminal transmits the test signal to the receive sensitivity measuring path so that the corresponding receive sensitivity measuring path may measure a cable loss to the terminal and the receive sensitivity generated by using the test signal transmitted by the terminal.
- [26] The terminal establishes a test signal and transmits the test signal to the receive

sensitivity measuring path through a communication with the receive sensitivity measuring path.

- [27] The terminal transmits the lowest receive level signal to the receive sensitivity measuring path, the lowest receive level signal being acceptable to the receive sensitivity measuring path.
- [28] The receive sensitivity measuring device further comprises a coupler installed in an antenna coupled to the transmit and receive path and the receive-only path so as to communicate signals with the first and second transmitters, the first and second receivers, and the receive sensitivity measuring path.
- [29] In order to measure the receive-only path, the terminal communicates with the receive-only path through the first transmitter coupled to the transmit and receive path and the second receiver coupled to the receive-only path.
- [30] The terminal is established with a plurality of frequencies, and is allowed to transmit the test signal.
- [31] The signal selector is a switch for performing a switching operation according to a user selection.
- [32] In another aspect of the present invention, in a receive sensitivity measuring method using a measuring device coupled to a communication system including a transmit and receive path and a receive-only path, the measuring device including a terminal for outputting a test signal to a receive sensitivity measuring path through a communication with the receive sensitivity measuring path from among the transmit and receive path and the receive-only path, a receiving sensitivity measuring method of a communication system including a receive-only path comprises:
- [33] (a) the receive sensitivity measuring path receiving the test signal from the terminal;
- [34] (b) calculating a cable loss between the receive sensitivity measuring path and the terminal; and
- [35] (c) allowing the receive sensitivity measuring path to use the test signal level transmitted by the terminal in (a) and the cable loss measured in (b) to measure a receive sensitivity of the receive sensitivity measuring path, and determine normal states.
- [36] When the receive sensitivity measuring path in (a) is a receive-only path, the terminal uses a transmission function of the transmit and receive path and a receiving function of the receive-only path, and establishes test signals to be transmitted to the receive-only path.

- [37] The test signal transmitted by the terminal is the lowest receive level signal to be received by the corresponding receive sensitivity measuring path.

### **Advantageous Effects**

[38]

### **Description of Drawings**

- [39] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate an embodiment of the invention, and, together with the description, serve to explain the principles of the invention:

[40] FIG. 1 shows a block diagram for measuring the receive sensitivity of the transmit and receive path; and

[41] FIG. 2 shows a block diagram of a receive sensitivity measuring device of a communication system including a receive-only path according to a preferred embodiment of the present invention.

### **Best Mode**

[42] In the following detailed description, only the preferred embodiment of the invention has been shown and described, simply by way of illustration of the best mode contemplated by the inventor(s) of carrying out the invention. As will be realized, the invention is capable of modification in various obvious respects, all without departing from the invention. Accordingly, the drawings and description are to be regarded as illustrative in nature, and not restrictive.

[43] FIG. 2 shows a block diagram of a receive sensitivity measuring device of a communication system including a receive-only path according to a preferred embodiment of the present invention.

[44] Referring to FIG. 2, a base station 100 for managing three or less FAs has the same configuration as that of the prior art, and comprises a receive sensitivity measuring device 200 coupled to an EQP port of the first coupler 112 and an EQP port of the second coupler 122 so as to measure the receive sensitivity of one of the paths A and B 110 and 120.

[45] The receive sensitivity measuring device 200 comprises a switch 210 and a terminal 220, and the switch 210 comprises a combiner 211, a first switch 212, a first transmitter and receiver 213, a second switch 214, and a second transmitter and receiver 215.

[46] The terminal 220 communicates with the respective paths A and B of the base station 100, establishes signals with the lowest level power which can be received by the paths, and transmits them in order to measure the receive sensitivity of one of the

paths A and B.

- [47] The first transmitter and receiver 213 of the switch 210 comprises a first transmitter 213a being coupled to the EQP port of the first coupler 112 of the transmit and receive antenna 111, that receives, by coupling, signals transmitted through the path A 110; and a first receiver 213b that receives, by coupling, signals received at the transmit and receive antenna 111.
- [48] The second transmitter and receiver 215 of the switch 210 comprises a second transmitter 215a being coupled to the EQP port of the second coupler 122 of the receive antenna 121, that receives, by coupling, signals transmitted through the path B 120; and a second receiver 215b that receives, by coupling, signals received at the receive antenna 121.
- [49] The first switch 212 is coupled between the first receiver 213b and the combiner 211, and it is turned on when measuring the receive sensitivity of the path A 110, and turned off when measuring the receive sensitivity of the path B 120.
- [50] The second switch 212 is coupled between the second receiver 215b and the combiner 211, and it is turned on when measuring the receive sensitivity of the path B 120, and turned off when measuring the receive sensitivity of the path A 110.
- [51] The combiner 211 combines the signals transmitted and received by the first and second transmitters and receivers 213 and 215, and outputs the combined signals to the terminal 220 through a single line.
- [52] Without being restricted to the above description, the first and second receivers 213b and 215b can be coupled to a multiplexer, and the signals can be selectively output to the combiner 211 rather than using the switch.
- [53] An operation of the preferred embodiment will now be described.
- [54] The first switch 212 of the receive sensitivity measuring device 200 is turned on, and the second switch 214 thereof is turned off so as to measure the receive sensitivity of the path A 110.
- [55] When the path A 110 is found to be normal through a communication with the path A by the terminal 220, the terminal 220 establishes the lowest level signal for receiving signals, and transmits the lowest level signal to the path A.
- [56] The path A receives the lowest level signal from the terminal 220, and determines normal receiving states. The base station 100 normally receives the lowest level signal, uses cable loss of from a final end of the path A 110 for transmitting and receiving signals to the receive sensitivity measuring device 200, and the lowest level intensity of the received signal, and calculates a receive sensitivity for the lowest reception.



- [57] Measuring the receive sensitivity of the path B 120 is performed as follows.
- [58] The path B 120 cannot communicate with the terminal 220 since the path B 120 has no transmission function, and hence, the terminal 220 cannot establish the lowest level receive signal of the path B 120.
- [59] Accordingly, the receive sensitivity measuring device 200 uses the transmission function of the path A to establish the lowest level signal of the path B. That is, the terminal 220 can communicate with the first transmitter 213a coupled to the transmit signals of the path A 110 through the second receiver 215b coupled to the receive signal of the path B 120 so as to establish the lowest level signal of the path B.
- [60] When the terminal 220 transmits the signals with the lowest level signal, the path B 120 uses the loss of the cable and the lowest level signal transmitted by the terminal 220 to calculate the receive sensitivity in the case the path B normally receives the signals.
- [61] To calculate the receive sensitivity in the above-described preferred embodiment, the terminal 220 transmits the lowest level signal through the communication with one of the paths A and B for measuring the receive sensitivity, and one of the paths A and B uses the lowest level signal transmitted by the terminal 220, the loss of from the terminal 200 to one of the first and second couplers 112 and 122, a measured cable loss to the base station, and an AFEU (Antenna Front End Unit) coupling value of the base station, and calculates an output value of the terminal 220.
- [62] Since the receive sensitivity measuring device 200 can transmit signals through the terminal 220, unnecessary data may be transmitted from the terminal, and the performance of the communication system may be degraded if the receive sensitivity is not measured. To prevent this, the receive sensitivity measuring device 200 is maintained at the turned-off state before measuring the receive sensitivity.
- [63] Also, it is needed to turn off the receive sensitivity measuring device 200 after measuring the receive sensitivity, and to ensure it is turned off, a timer function is required to be installed in the receive sensitivity measuring device 200 so that it may be automatically turned off after a predetermined time, thereby preventing degradation of performance of the communication system caused by transmission of unnecessary signals when no measuring process is executed.
- [64] Further, the automatic power off function can be reinforced by adding a circuit for monitoring the power states to the receive sensitivity measuring device 200.
- [65] While this invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood

that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

[66] For example, the receive sensitivity measuring device 200 can be coupled to a path for measuring the receive sensitivity to thus control transmission and reception, and accordingly, the receive sensitivity of the path can be easily measured without service interruption while providing general services.

[67] Also, the method for measuring the receive sensitivities of the two paths at the base station having a transmit and receive path and a receive-only path has been described, and without being restricted to the base station, the receive sensitivity of the communication system can be measured through a switching operation, by turning on the switch coupled to each path for measuring the receive sensitivity of the communication system having a transmit and receive path and a receive-only path.

[68] As described, in the device and method for measuring the receive sensitivities of the communication system including a receive-only path, a measuring device is directly connected to the antennas installed in the communication system having a transmit and receive path and a receive-only path, it is allowed to measure the receive sensitivity during general services, and accordingly, it is easy to determine whether the communication system operates normally.

[69] In addition, the lowest level signal can be established through a communication with a terminal of the measuring device via the transmit and receive path in the case of no transmission function such as in the receive-only path, thereby allowing easy measuring of the receive sensitivity of the communication system.

#### **Mode for Invention**

[70]

#### **Industrial Applicability**

[71]

#### **Sequence List Text**

[72]

## Claims

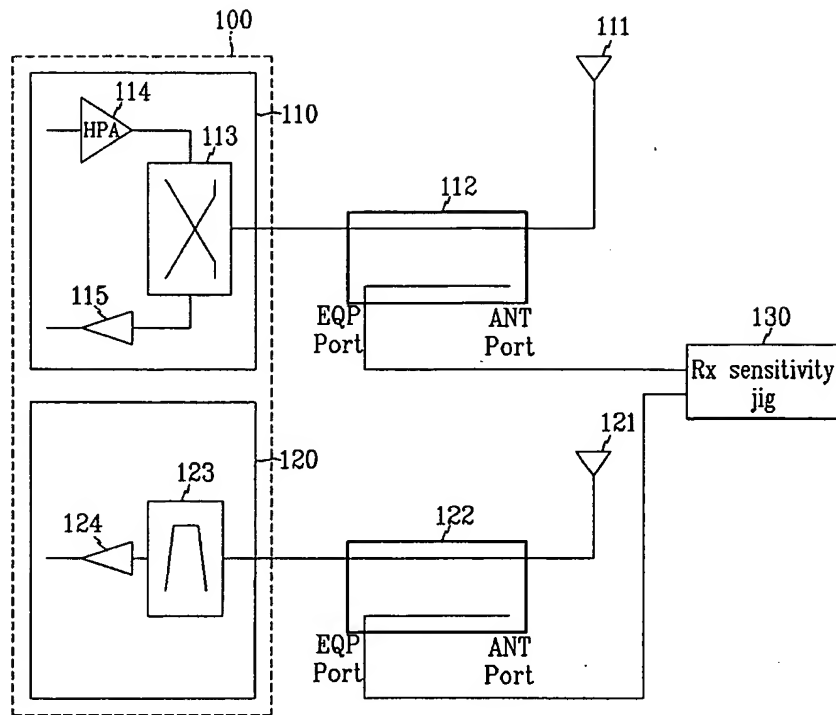
- [1] 1. In a receive sensitivity measuring device including a terminal for transmitting a test signal through communication with a receive sensitivity measuring path so as to measure the receive sensitivity of a communication system including a transmit and receive path and a receive-only path, a receive sensitivity measuring device including a receive-only path, comprising:  
a first transmitter for receiving a signal from the transmit and receive path, and transmitting the signal to the terminal;  
a second transmitter for receiving a signal from the receive-only path, and transmitting the signal to the terminal;  
a first receiver for receiving a test signal from the terminal, and transmitting the test signal to the transmit and receive path;  
a second receiver for receiving a test signal from the terminal, and transmitting the test signal to the receive-only path;  
a signal selector, for selecting one of the first and second receivers connected to the signal selector and a receive sensitivity measuring path so that one of the first and second receivers may be selectively connected to the terminal; and  
a combiner, connected to the first and second transmitters and the first and second receivers, for combining a plurality of input signals into a single signal, and transmitting the single signal to the terminal, wherein  
the terminal transmits the test signal to the receive sensitivity measuring path so that the corresponding receive sensitivity measuring path may measure a cable loss to the terminal and the receive sensitivity generated by using the test signal transmitted by the terminal.
- [2] 2. The receive sensitivity measuring device of claim 1, wherein the terminal establishes a test signal and transmits the test signal to the receive sensitivity measuring path through a communication with the receive sensitivity measuring path.
- [3] 3. The receive sensitivity measuring device of claim 1, wherein the terminal transmits the lowest receive level signal to the receive sensitivity measuring path, the lowest receive level signal being acceptable to the receive sensitivity measuring path.
- [4] 4. The receive sensitivity measuring device of claim 1, wherein the terminal is attachable to and removable from the receive sensitivity

measuring device.

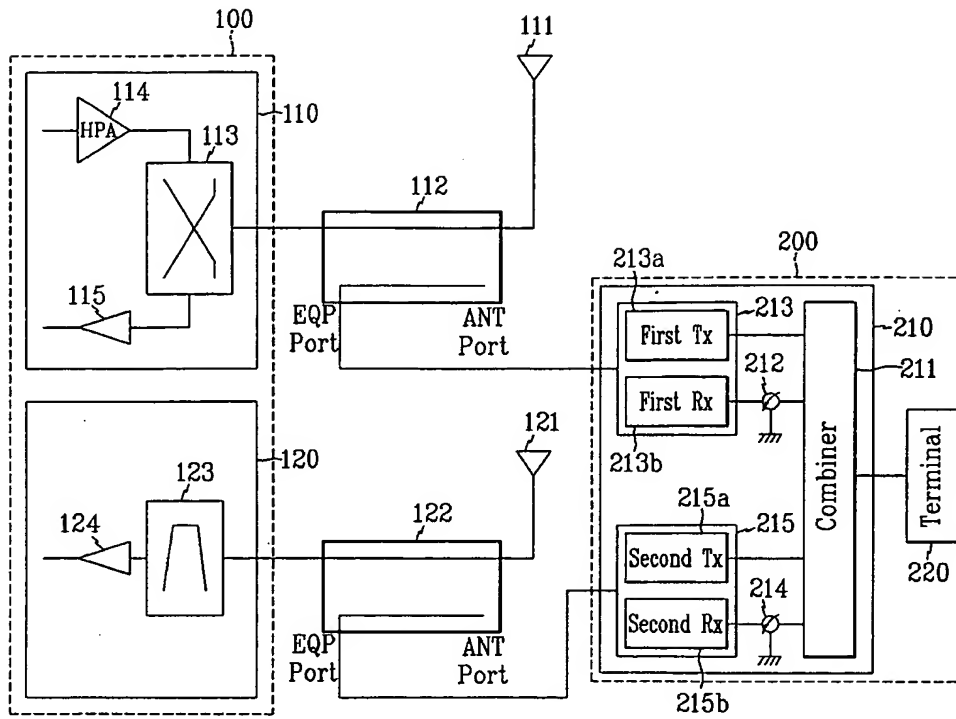
- [5] 5. The receive sensitivity measuring device of claim 1, further comprising a coupler installed in an antenna coupled to the transmit and receive path and the receive-only path so as to communicate signals with the first and second transmitters, the first and second receivers, and the receive sensitivity measuring path.
- [6] 6. The receive sensitivity measuring device of claim 1, wherein, in order to measure the receive-only path, the terminal communicates with the receive-only path through the first transmitter coupled to the transmit and receive path and the second receiver coupled to the receive-only path.
- [7] 7. The receive sensitivity measuring device of claim 1, wherein the terminal is established with a plurality of frequencies, and is allowed to transmit the test signal.
- [8] 8. The receive sensitivity measuring device of claim 1, wherein the signal selector is a switch for performing a switching operation according to a user selection.
- [9] 9. The receive sensitivity measuring device of claim 1, further comprising a timer for automatically turning off the receive sensitivity measuring device when the terminal transmits the test signal and a predetermined time has passed.
- [10] 10. In a receive sensitivity measuring method using a measuring device coupled to a communication system including a transmit and receive path and a receive-only path, the measuring device including a terminal for outputting a test signal to a receive sensitivity measuring path through a communication with the receive sensitivity measuring path from among the transmit and receive path and the receive-only path, a receiving sensitivity measuring method of a communication system including a receive-only path, comprising:
- (a) the receive sensitivity measuring path receiving the test signal from the terminal;
  - (b) calculating a cable loss between the receive sensitivity measuring path and the terminal; and
  - (c) allowing the receive sensitivity measuring path to use the test signal level transmitted by the terminal in (a) and the cable loss measured in (b) to measure a receive sensitivity of the receive sensitivity measuring path, and determine normal states.

- [11] 11. The receiving sensitivity measuring method of claim 10, wherein when the receive sensitivity measuring path in (a) is a receive-only path, the terminal uses a transmission function of the transmit and receive path and a receiving function of the receive-only path, and establishes test signals to be transmitted to the receive-only path.
- [12] 12. The receiving sensitivity measuring method of claim 10, further comprising: checking that the terminal of the measuring device has transmitted the test signal and the receive sensitivity measuring path has received the corresponding test signal, and turning off the measuring device.
- [13] 13. The receiving sensitivity measuring method of claim 10, wherein the test signal transmitted by the terminal is the lowest receive level signal to be received by the corresponding receive sensitivity measuring path.
- [14] 14. The receiving sensitivity measuring method of claim 10, further comprising turning off the measuring device when the terminal transmits the test signal and a predefined time has passed

[Fig. 1]

1/2  
FIG. 1

[Fig. 2]

2/2  
FIG. 2

## INTERNATIONAL SEARCH REPORT

International application No.  
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<b>A. CLASSIFICATION OF SUBJECT MATTER</b> H04B 17/00, H04Q 7/34 According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) H04B, H04Q  Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPI, EPODOC, PAJ		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 2002068965 A (MTI CO LTD) 28 August 2002 (28.08.2002) & US 2003/0179730 A1 (LEE, S.K. et al.) 25.09.2003 <i>abstract, figs. 4-6; paragraphs [0030]-[0047].</i> --	1-14
A	WO 2001/026239 A1 (NOKIA NETWORKS OY) 12 April 2001 (12.04.2001) <i>abstract, figs. 1, 2; page 2, line 4 - page 4, line 3.</i> --	1-14
A	GB 2272604 A (MOTOROLA) 18 May 1994 (18.05.1994) <i>abstract, fig. 5; page 6, line 29 - page 7, line 30.</i> ---	1-14
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Name and mailing address of the ISA/ AT <b>Austrian Patent Office</b> Dresdner Straße 87, A-1200 Vienna Facsimile No. +43 / 1 / 534 24 / 535		Authorized officer <b>LOIBNER K.</b>  Telephone No. +43 / 1 / 534 24 / 323



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Information on patent family members

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Patent document cited in search report			Publication date	Patent family member(s)		Publication date
GB	A	2272604	1994-05-18	none		
KR	A	20020689 65	2002-08-28	CN	A	1447551
				US	A	2003179730
						2003-10-08
						2003-09-25
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